International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 5, Issue 3, Jun 2015, 315-320

INFLUENCE OF DRIP FERTIGATION ON RESULTANT SEED QUALITY IN MAIN AND RATOON CROPS OF PIGEONPEA (*CAJANUS CAJAN* L.) CV. VBN 3

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ABSTRACT

A laboratory experiment was conducted at Agricultural College and Research Institute, Madurai, during two seasons to study the effect of drip fertigation on resultant seed quality in main and ratoon crops of pigeonpea (*Cajanus cajan* L.) cv. VBN 3. The treatments consisted of four fertigation levels *viz*., F_1: 50%, F_2: 75%, F_3: 100% and F_4: 100% of seed recommended dose of fertilizers through drip combined with three foliar spray of FS_1: 0.5% $ZnSO_4$, FS_2: 100 ppm succinic acid and FS_3: 100 ppm humic acid and control having surface irrigation and soil application of fertilizers. The results revealed that fertigation and foliar spray treatments exhibited significant effect on seed quality parameters. Among the treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} resultant seed quality were recorded higher 100 seed weight, germination, seedling length, dry matter production and vigour index as compared to T_1, T_2, T_3 and control in both season. Between the crops, main crop resultant seed quality was better over ratoon crop of pigeonpea.

KEYWORDS: Pigeonpea, Drip Fertigation, Foliar Spray, Resultant Seed, Seed Quality Attributes

INTRODUCTION

Pigeonpea is the most widely grown crop in the country and has been under cultivation for over three thousand years. Pigeonpea is mainly consumed in the form of split pulse as dhal, which is an essential supplement of cereal based diet. In India, pulses production has been hovering around 13.5 -15.0 million tonnes during the last decade, while annual domestic demand is 18-19 million tonnes. Pigeonpea is grown on an area of about 3.25 million hectares with the production of 2.23 million tonnes in the country. The national productivity of pigeonpea is only 678 kg per hectare. It is second most important crop after chickpea among different pulse crops grown in the country. One of the main reason attributed is non-availability of adequate quantity of quality seeds to produce adequate pulses. The availability of adequate, timely and assured supply of water is an important determinant of agricultural productivity. Agriculture is by far the largest (81%) water consumer in India and hence more efficient use of water in agriculture needs to be the top most priority (INCID, 2006). Water input per unit irrigated area will have to be reduced in response to water scarcity and environmental concerns (WRI, 2007). It has been scientifically recognized that adoption of drip fertigation method is an option for efficient use of water and nutrients through improvement in crop yield per unit volume of water and nutrients used (Bar-Yosef, 1999). The main cause for low seed multiplication rate is that pigeonpea is mainly grown under agro-ecological constraints such as, cultivation under rainfed situation and in deficient soils where the application of micronutrients has been found to be beneficial. Since drip fertigation for seed crop related research in pigeonpea is scanty, particularly input information on optimal schedules for drip fertigation is the need of the hour. Knowledge on this is warranted for selection of source seed for breeder or nucleus classes and at times for foundation seed, which are precious and are to be maintained

at higher quality for future multiplication. Hence, present study; seeds were evaluated for the performance of drip fertigation on resultant seed quality of pigeonpea.

MATERIALS AND METHODS

The experiment was conducted at Agricultural College and Research Institute (TNAU), Madurai during kharif, 2010 (main crop) and rabi, 2010 (ratoon crop). After harvest the first crop and ratoon crop resultant seeds of pigeonpea were separated based on the drip fertigation combined with foliar spray treatments were subjected to physiological seed quality evaluation and present findings clearly brought out the better performance of resultant seeds from drip fertigation treatments. The drip fertigation and foliar spray treatments details are given below.

Table 1

Treatment Details of Resultant Seeds		
T_1 (F_1FS_1)	:	50% of SRDF through drip + Foliar spray of 0.5% $ZnSO_4$
T_2 (F_1FS_2)	:	50% of SRDF through drip + Foliar spray of 100 ppm succinic acid
T_3 (F_1FS_3)	:	50% of SRDF through drip + Foliar spray of 100 ppm humic acid
T_4 (F_2FS_1)	:	75% of SRDF through drip + Foliar spray of 0.5% $ZnSO_4$
T_5 (F_2FS_2)	:	75% of SRDF through drip + Foliar spray of 100 ppm succinic acid
T_6 (F_2FS_3)	:	75% of SRDF through drip + Foliar spray of 100 ppm humic acid
T_7 (F_3FS_1)	:	100% of SRDF through drip + Foliar spray of 0.5% $ZnSO_4$
T_8 (F_3FS_2)	:	100% of SRDF through drip + Foliar spray of 100 ppm succinic acid
T_9 (F_3FS_3)	:	100% of SRDF through drip + Foliar spray of 100 ppm humic acid
T_{10} (F_4FS_1)	:	150% of SRDF through drip + Foliar spray of 0.5% $ZnSO_4$
T_{11} (F_4FS_2)	:	150% of SRDF through drip + Foliar spray of 100 ppm succinic acid
T_{12} (F_4FS_3)	:	150% of SRDF through drip + Foliar spray of 100 ppm humic acid
Control	:	Surface irrigation with SRDF of 25:50:25 NPK kg ha^{-1} by two splits.

Abbreviations: SRDF: Seed recommended dose of fertilizers, F: Fertigation, FS: Foliar spray

The resultant seeds were evaluated for their seed quality characters such as germination percentage (ISTA, 1999), seedling length (cm) the distance between the tip of the primary leaf to the tip of the primary root. Vigour index (VI) was computed using the following formula VI = Germination percentage × dry matter production (mg) suggested by (Abdul Baki and Anderson, 1973). Dry matter production (mg) ten normal seedlings in each of the replication were taken at random, air dried for 24 h and dried in a hot air oven maintained at 85°C ± 1°C for 48 h and cooled in a desiccators for 30 min, weighed and the mean expressed in milligram.

STATISTICAL ANALYSIS

The data pertaining to the experiment were subjected to statistical analysis by analysis of variance method as suggested by (Gomez and Gomez, 1984). Wherever the treatment differences were found significant (F test), critical difference was worked out at five per cent probability level and the values furnished. The treatment differences that were not significant are denoted as NS.

RESULTS AND DISCUSSIONS

In the present investigation, it was observed that seed quality attributes on the resultant seeds of pigeonpea varied significantly among the treatments and increased due to surface fertigation and foliar spray treatments effects on initial seed quality. The resultant seed quality characters such as germination, seedling length, dry matter production and vigour index were all positively influenced by drip fertigation treatments. Among the drip fertigation treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} resultant seed quality were registered higher seed physiological quality potential compared to T_1, T_2, T_3

in both crops. While all the seed quality attributes were lower in control plot (soil application of 100% SRDF) compared to drip fertigation treatments in both crops. That drip fertigation methods increased the seed quality was confirmed by (Prechear, 2000) who showed that the fertigation method as compared with soil application of nitrogen improved the percentage of squash fruit formation, as well as its yield and quality. Among the two crops of drip fertigation treatment, main crop was more effective. The positive influence of fertigation and foliar spray treatments on seed quality characters may be due to the improved ability of the crop to absorb nutrients, photosynthesis and better sink source relationship as these play vital role in various biochemical processes. These findings are in conformity with the studies (Nasiri et al. 2010).

Among the seed quality characters, 100-seed weight was higher for the seeds obtained from the plants 75 per cent of SRDF as WSF, 100 per cent of SRDF as WSF and 150 per cent of SRDF as WSF registered higher ranges in main crop 7.7g – 7.9 g and ratoon crop 7.5 g – 7.7g (Table 2). The increase in seed weight might be due to better mineral utilization of plants accompanied with enhancement of photosynthesis, other metabolic activity and greater diversion of food material to seeds (Naga et al. 2013). Moreover, (Dongre et al. 2000) reported that the application of $ZnSO_4$ exerted significantly influence on the average number of seeds fruit1 and weight of 500 seeds as compared to control. Germination was equally enhanced by T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} (96% in main crop and 90% in ratoon crop) and maximum germination was noticed in main crop (Table 3). (Rengel, 2001) stated that the increase in 1000-grain weight and its ultimately reflects higher seed germination of crop plants might be due to zinc that has high phloem mobility from leaves to roots, stem and developing seeds. The similar trend was registered in root length in main crop 16.0 cm and 14.7 cm in ratoon and shoot length in main crop 24.2 cm and 23.2 cm in ratoon (Table 4 & 5). Foliar feeding of Zn and Mn along with enhanced doses of NPK favourably influenced the growth parameters of maize as reported by (Mahmoud, 2001).

Moreover, surface drip fertigation with foliar spray treatment also increased the seedling dry weight due to better mobilization of nutrients to seedling in main crop 55.1 mg and 52.0 mg in ratoon, and dry matter production were higher in main crop by 6.0 % over ratoon which might be due to the prevalence of favorable temperature during the early and late stages of crop growth that prevailed in main crop (Table 6) and was in accordance with the findings of Singh et al. (1993) found that enhanced dry weight of seedling by growth regulators, organics and nutrients may be due to increased translocation of assimilates from leaf and stem to the reproductive parts as also reported in pigeonpea due to application of $ZnSO_4$, succinic acid and humic acid as also visualized by (Jayakumar et al. 2014) in cotton.

The study also highlighted that the physiological seed quality characters of resultant seeds were influenced by drip fertigation. Vigour index in main crop 5290 and 4897 in ratoon were recorded among the best treatments *viz.,* F_2, F_3 and F_4 (Figure 1). However F_1 fertigation treatment and control recorded lower values than other treatment. Among the fertigation treatments 75 per cent of SRDF as WSF, 100 per cent of SRDF as WSF and 150 per cent of SRDF as WSF registered higher vigour index values were higher by 9.1 per cent in main crop as compared to 50% SRDF as WSF in main crop. These results were corroborated with findings of (Shaker et al. 2013; Periaswamy, 1994 and Kirnak et al. 2010).

CONCLUSIONS

Pigeonpea resultant seed responded well to fertigation and foliar spray treatments. From the above results, it can be concluded that the drip fertigation and foliar treatments such as T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} significantly enhanced resultant seed quality parameters over T_1, T_2, T_3 and control in both crops. Between the crops, main crop resultant seed quality was superior over ratoon crop.

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APPENDICES

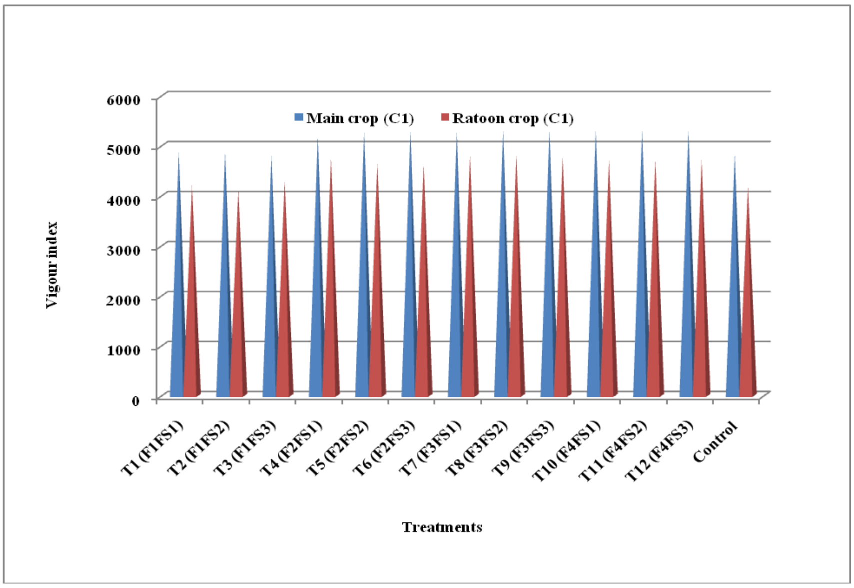

Figure 1: Influence of Fertigation and Foliar Spray on Vigour Index in Pigeonpea

Table 2: Influence of Fertigation and Foliar Spray on 100 Seed Weight (g) in Pigeonpea (in Main Crop & Ratoon)

F- Fertigation Treatments	100 Seed Weight (g)							
	FS - Foliar Spraying Treatments							
	Main Crop (C_1)				Ratoon Crop (C_2)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	7.5	7.5	7.5	7.5	7.4	7.4	7.4	7.4
F_2	7.7	7.7	7.7	7.7	7.5	7.5	7.5	7.5
F_3	7.9	7.9	7.8	7.9	7.7	7.7	7.6	7.7
F_4	7.8	7.7	7.7	7.7	7.6	7.6	7.6	7.6
Mean	7.7	7.7	7.7	7.7	7.5	7.5	7.5	7.5
	F	FS	F X FS	FS X F	F	FS	F X FS	FS X F
SEd	0.067	0.054	0.111	0.109	0.050	0.021	0.061	0.042
CD(P=0.05)	0.163**	NS	NS	NS	0.123**	NS	NS	NS
Control	**7.5**				**7.3**			

Table 3: Influence of Fertigation and Foliar Spray on Germination (%) in Pigeonpea (in Main Crop & Ratoon)

F- Fertigation Treatments	Germination (%)							
	FS - Foliar Spraying Treatments							
	Main Crop (C_1)				Ratoon Crop (C_2)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	93	93	93	93	87	87	87	87
F_2	96	96	96	96	90	90	90	90
F_3	96	96	96	96	90	90	90	90
F_4	96	96	96	96	90	90	90	90
Mean	95	95	95	95	89	89	89	89
	F	FS	F X FS			FS	F X FS	
SEd	0.664	0.575	1.151		0.835	0.723	1.447	
CD(P=0.05)	1.371*	NS	NS		1.724*	NS	NS	
Control	**93**				**87**			

Table 4: Influence of Fertigation and Foliar Spray on Root Length (cm) in Pigeonpea (in Main Crop & Ratoon)

F- Fertigation Treatments	Root Length (cm)							
	FS - Foliar Spraying Treatments							
	Main Crop (C_1)				Ratoon Crop (C_2)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	13.4	14.3	12.4	13.4	12.1	13.0	11.1	12.1
F_2	16.0	15.6	15.4	15.7	14.7	14.3	14.1	14.4
F_3	16.0	15.8	16.4	16.1	14.7	14.5	15.1	14.8
F_4	16.0	16.2	16.3	16.2	14.7	14.9	15.0	14.9
Mean	15.4	15.5	15.1	15.3	14.1	14.2	13.8	14.0
	F	FS	F X FS		F	FS	F X FS	
SEd	0.585	0.507	1.014		0.772	0.669	1.338	
CD(P=0.05)	1.208*	NS	NS		1.594*	NS	NS	
Control	**13.2**				**12.0**			

Table 5: Influence of Fertigation and Foliar Spray on Shoot Length (cm) in Pigeonpea (in Main Crop & Ratoon)

F- Fertigation Treatments	Shoot Length (cm)							
	FS - Foliar Spraying Treatments							
	Main Crop (C_1)				Ratoon Crop (C_2)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	22.4	22.4	21.8	22.2	21.5	22.0	21.3	21.6
F_2	24.2	23.6	23.2	23.7	23.6	23.5	20.7	22.6
F_3	24.5	24.1	24.6	24.4	24.0	23.3	23.2	23.5
F_4	25.5	24.4	24.0	24.6	23.3	23.8	23.4	23.5
Mean	24.2	23.6	23.4	23.7	23.1	23.2	22.2	22.8
	F	FS	F X FS		F	FS	F X FS	
SEd	0.512	0.444	0.888		0.549	0.476	0.951	
CD(P=0.05)	1.058*	NS	NS		1.133*	NS	NS	
Control	**21.2**				**21.2**			

Table 6: Influence of Fertigation and Foliar Spray on Dry Matter Production (mg) in Pigeonpea (in Main Crop & Ratoon)

F- Fertigation Treatments	Dry Matter Production (mg)							
	FS - Foliar Spraying Treatments							
	Main Crop (C_1)				Ratoon Crop (C_2)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	52.4	52.5	51.7	52.2	48.3	47.4	49.3	48.3
F_2	54.1	55.0	55.2	54.8	48.3	53.6	53.1	51.7
F_3	55.0	55.4	55.4	55.2	52.8	51.6	51.4	51.9
F_4	55.4	55.4	55.3	55.4	52.5	52.5	52.4	52.5
Mean	54.2	54.5	54.4	54.4	50.5	51.3	51.6	51.1
	F	FS	F X FS		F	FS	F X FS	
SEd	0.846	0.733	1.466		1.206	1.045	2.090	
CD(P=0.05)	1.747*	NS	NS		2.490*	NS	NS	
Control	**52.1**				**48.2**			